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United States
Department of
Agriculture

Forest Service
Southern Region

MANAGING EASTERN WHITE PINE IN THE SOUTHEAST

Forestry Report R8-FR 1
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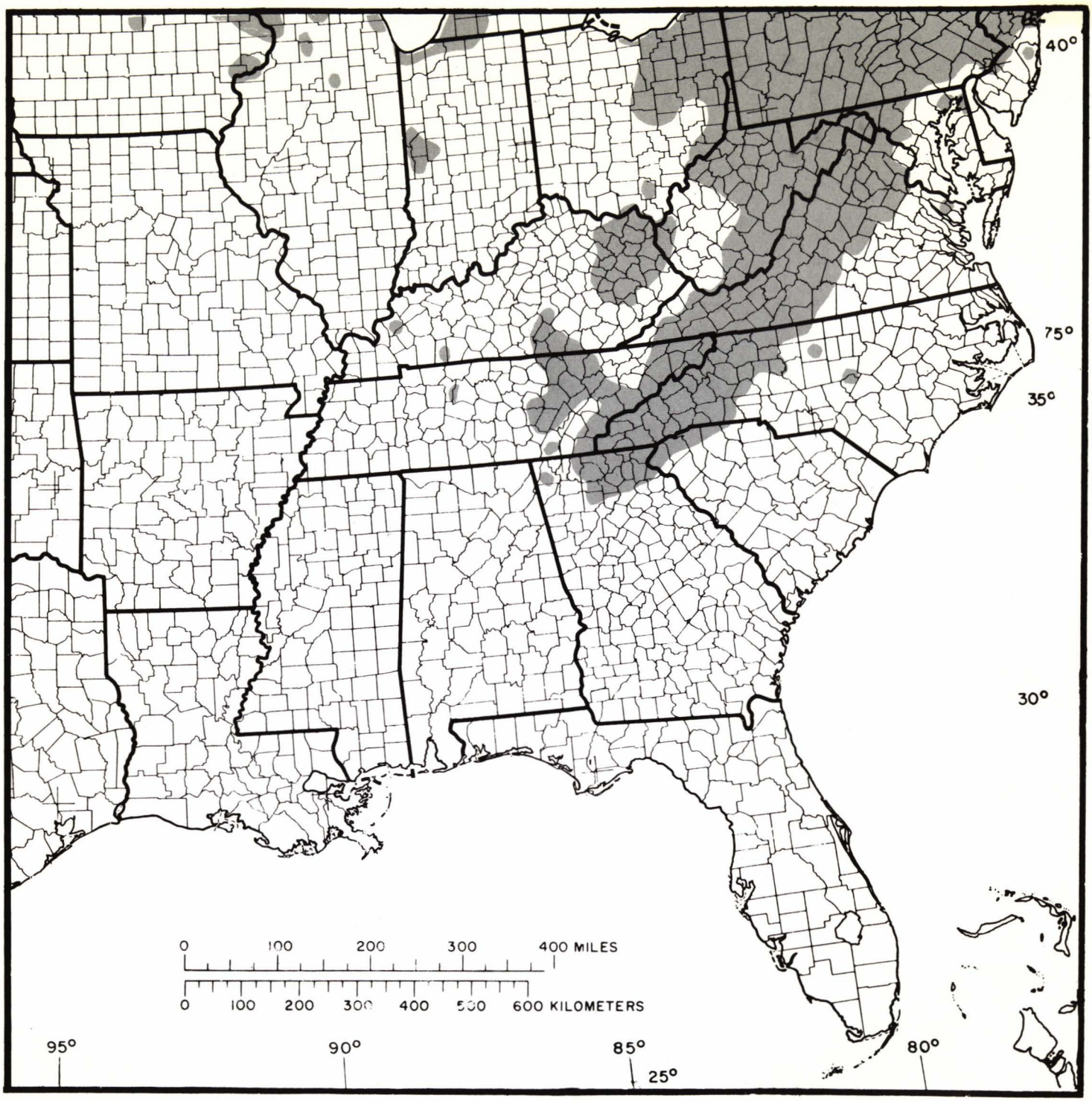

Source: Atlas of U.S. Trees, USDA Forest Service. Misc. Pub. No. 1146. March 1971.

Figure 1. — Range of eastern white pine in the Southeast.

MANAGING EASTERN WHITE PINE IN THE SOUTHEAST

William E. Balmer
and
Hamlin L. Williston*

Eastern white pine, while primarily a northern species, is also economically important within the southern part of its range (figure 1). In the South it occurs in portions of the Appalachian Highlands; Valley and Ridge; Blue Ridge physiographic regions; the western Piedmont of Virginia, North Carolina and South Carolina; and the northeastern Piedmont of Georgia. In the southern part of its range it occurs at elevations ranging from 1,000 to 3,500 feet, and occasionally reaches 4,000 feet. In the southern extremities of its range eastern white pine does best on northern and eastern aspects between elevations of 2,000 and 3,500 feet. Best growth occurs with abundant rainfall during the growing season.

White pine grows on soils derived from practically all types of parent materials within its natural range. Best growth occurs on imperfectly drained, alluvial soils along rivers and streams. On well-drained soils, growth is slower, but white pine competes successfully with Virginia and pitch pine. Growth decreases as the plasticity and density of the subsoil increases. Heavy clay soils are not recommended for planting white pine. Poorly drained bottom land sites and upland depressions are generally poor choices for white pine.

White pine has a remarkable rate of growth compared to other pine and hardwood species within its range. The comparative site index for eastern white pine is higher than nine other species on all sites except the very best, where yellow-poplar is superior in height growth (figure 2).

Diameter growth rates surpass all other associated species on *all* sites (figure 3). Superior height and radial growth advantage is evident in the greater white pine yields across all sites (table 1). However, white pine might be less suited than other species on seriously degraded sites. On severely eroded sites in Tennessee, loblolly, pitch and Virginia pines performed better than white pine with or without fertilization. On reclaimed spoils, eastern white pine should not be used on sites with a pH of less than 4.0. Slow, early growth and low litter production limits this species for rapid site protection.

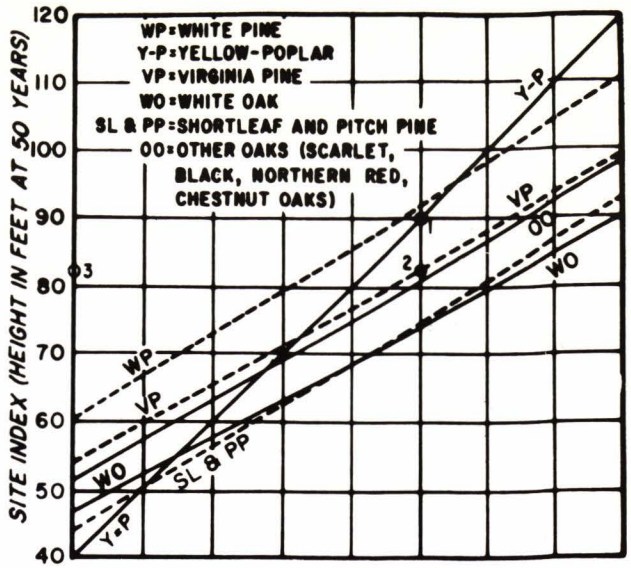

Figure 2. — A comparison of site indices for 10 species on the same land in the southern Appalachians. For example, on land that is site index 90 (1) for yellow-poplar, read down (2) and across (3) to find that this same land averages about site index 82 for Virginia pine. Site index for white pine is about 92. (From Doolittle, 1958).

Regeneration

White pine lends itself to intensive management. You can get maximum yields if you take advantage of its silvicultural characteristics. One company in North Carolina has developed a very effective management system based on the following characteristics:

1. White pine is semi-tolerant to shade. Although it will tolerate up to 80 percent shade, growth increases as shade is reduced.
2. Seed crops occur at 3- to 5-year intervals, with heavy seed production in good years and little or no seeding in intervening years.
3. Unlike requirements for yellow pine, bare mineral soil is not necessary for seed germination of white pine. Dry mineral soil is an unfavorable seed bed. Seeds germinate and survive well on both disturbed and undis-

*The authors, now retired, were pine specialists with the Forest Service, Southeastern Area, State and Private Forestry, when this publication was written.

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Table 1. — A comparison of site indices, basal area, and volume at 50 years for 10 southern Appalachian species on three sites.

Species	Site index	Basal area per acre	Volume per acre*		
	Feet	Sq.ft	Cu.ft	Cords	Bd.ft
		Poor Site			
Shortleaf and pitch pine	50	159	3970	46.7	9,900
Yellow-poplar	50	90	1700	20.0	3,500
White oak	52	90	1726	20.3	3,860
Other oaks†	57	94	2041	24.0	5,385
Virginia pine	59	162	4180	49.2	20,000
White pine	66	190	5312	62.5	23,920
		Medium Site			
Shortleaf and pitch pine	65	166	5665	66.6	22,750
White oak	66	100	2590	30.5	8,370
Other oaks	72	103	2954	34.8	10,550
Virginia pine	74	180	5440	64.0	28,840
Yellow-poplar	75	132	3138	36.9	14,510
White pine	82	201	6976	82.1	35,964
		Good Site			
White oak	79	106	3388	39.9	13,350
Shortleaf and pitch pine	81	170	7487	88.1	36,465
Other oaks	86	108	3870	45.5	16,300
Virginia pine	88	188	6040	71.1	39,116
White pine	98	205	8256	97.1	45,328
Yellow-poplar	100	172	5330	62.7	32,150

*Conversion factor for cordwood was 85 cubic feet per cord. Board-foot volumes are International ¼-inch rule.

†Includes scarlet, black, northern red, and chestnut oaks.

Source: Doolittle, 1958.

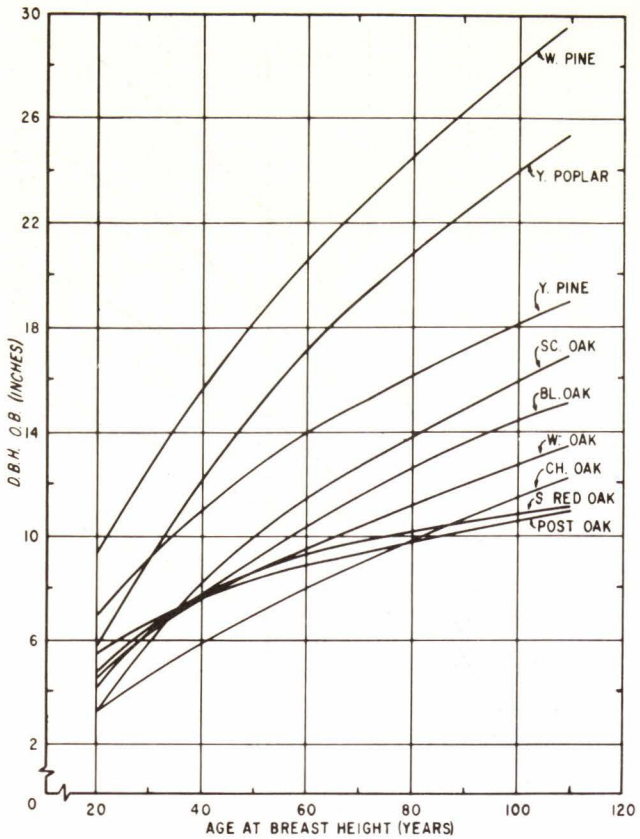

Figure 3. — Comparative diameter growth of white pine and associated species.

Source: Barrett, 1933.

turbed litter layers.

4. Growth is slow for the first 3 years after planting. Heights range from 30 to 36 inches at the end of the third growing season for trees in the open. Growth during the fourth growing season is usually between 3 to 4 feet, and as much as 7 feet for exceptional trees.
5. Removing organic ground layer by mechanical means greatly increases plantation mortality and reduces growth by as much as 50 percent during the first 4 years. This effect ceases after the fourth growing season.
6. Response of vigorous seedlings to release is quick and pronounced.
7. Terminal growth occurs within a 30-day period (from mid-May to mid-June in the vicinity of Morganton, N.C.), and may exceed 2 inches per day.
8. Herbicides will severely burn new growth if applied during the period of terminal growth. Timing of foliar herbicide application is critical and should be tailored to local growing conditions.
9. White pine is sensitive to physical problems in soils, such as poor drainage, hardpans, and high plasticity.
10. Pure stands of white pine seldom stagnate because of inherent variations in vigor. This characteristic is more pronounced on better sites and in natural stands than in plantations.

Natural Regeneration

Because of the periodic seeding habits of white pine, coordinate treatments with seed crops. The seed-in-place regeneration method works well with white pine. If you use this method, schedule logging after seed fall in good seed years. This technique is particularly well suited to rough tracts having high potential planting costs. Logging should start after the mid-August seed fall and end before seed germination the following May. Inspect the site in the fall after the first frost to determine the adequacy of natural regeneration and any need for spot planting. Release seedlings from competing vegetation during the fourth growing season. Loss of the herbicide 2,4,5-T has created problems, but trials with glyphosate look promising, and it is now approved for use in white pine management.

Artificial Regeneration

To avoid possible damage by the pales weevils, areas that will be planted during the following winter should be clearcut by May 1. Normally, site preparation is not needed on recently harvested areas; however, a prescribed burn will make planting easier and may eliminate some competition if an abundance of submerchantable stems remain following the harvest. Where rhododendron and mountain laurel are a problem, treat the area with a herbicide between May 15 and June 15, prior to planting. If an acceptable kill occurs, the area may be burned if needed. Burned-over land will freeze, limiting the availability of soil moisture to newly planted seedlings. Delay planting on such areas until after February 1. When using prescribed fire, avoid conditions that will result in removing most or all surface litter and logging debris. One option following burning would be to plant 400 2-0 seedlings per acre and follow up with a herbicide release during the third growing season. The herbicide can be applied by mistblower or by helicopter on the roughest terrain after the period of rapid height growth is over.

White pine will tolerate some shade. This spe-

cies has been successfully underplanted in an upland oak stand cut to a residual basal area of about 40 square feet per acre in the Upper Piedmont of South Carolina. After five growing seasons, underplanted pines were two-thirds as tall as those planted on an adjacent clearcut area. Experiences at the Bent Creek Experimental Forest indicate that underplanted trees need release. Tests by the North Carolina Division of Forest Resources indicate large, container-grown seedlings may be used to extend the regular planting season and to immediately replant 2-0 seedling failures during summer months. Fall-planted container stock were considered failures because of frost heaving.

Growth and Yield of White Pine

Height growth of both planted and natural white pine is slow during the first 2 to 3 years. Afterwards, growth accelerates rapidly, peaking at an average annual rate of 3 feet between the ages 10 to 15 on site index 80 (base age 50). By age 50, growth slows to around 1 foot per year. Thereafter, white pine continues to grow at slightly less than 1 foot per year for a fairly long time until height growth finally ceases.

Vimmerstedt found that, at age 35, merchantable cubic-foot growth and yield of plantations (table 2) is greatly influenced by site quality, and to some extent by stand density expressed as original spacing. Stands planted at 4 by 4 foot spacing produce about nine cords more at age 30 than those planted by 12 by 12 foot spacing. Beyond age 30, there is a decrease in the difference in cubic-foot yield between spacings.

Beck has warned that both Doolittle's and Vimmerstedt's (figure 4) site index curves underestimate site index for ages 20 to 45 years. He produced his own polymorphic curves (figure 5) for natural stands of white pine in the southern Appalachians. Beck's intercept equations are useful for determining site index in stands under 20 and in old stands where total height is difficult to measure (figures 6 and 7). Comparisons between the 3-year and 5-year intercept estimates and with Beck's polymorphic curves have shown good agreement in studies by the Virginia Division of Forestry.

Culmination of mean annual increment (MAI) occurs at about age 25 years. MAI on site index 75 (base age 25) land at age 25 is 387 cubic feet, whereas site index 65 land produces an MAI of only 118 cubic feet. Maximum periodic annual rate of cubic-foot volume growth apparently occurs between 20 and 25 years of age and reaches nearly three cords per acre per year on average sites. On the very best sites, at a 4 x 4 foot spacing, periodic annual increment (PAI) apparently reaches the almost unbelieveable rate of 526 cubic feet or about 6 cords per acre. This rate of growth exceeds that of all other Appalachian species.

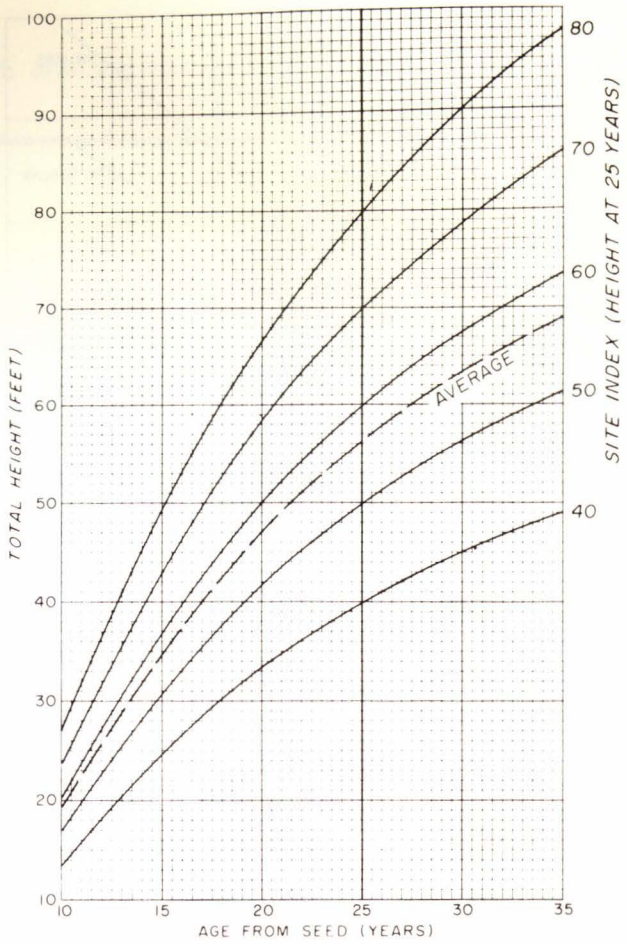

Figure 4. — Site index curves for old-field white pine plantations in the southern Appalachians. Index age is 25 years. To convert to site index at age 50 multiply the site index at age 25 by 1.4335.

Source: Vimmerstedt.

Board-foot yields are much greater in plantations with wider spacing as a consequence of larger average diameters. Board-foot yield sharply increases with increased space per tree from 4 by 4 foot to 12 by 12 foot spacings and continues to increase through age 35 (table 3). Table 3 also indicates that somewhere between a 12 by 12 (302 per acre) and a 16 by 16 foot (170 per acre) spacing enough trees are not planted to fully utilize the site through age 35.

Table 2. — Cubic-foot yield of white pine per acre, including bark, by site, age, and original spacing of all trees 3 inches d.b.h., and larger to a 3-inch-top (o.b.) diameter (25-year basis).

Age (years)	Average height dominants and codominants	Original spacing (feet)								
		4 x 4	5 x 5	6 x 6	6 x 7	7 x 7	8 x 8	9 x 9	10 x 10	12 x 12
	Feet	Cubic feet								
SITE INDEX 45										
10	15	298	249	226	219	213	205	200	196	192
15	28	1,171	1,040	975	955	938	914	898	888	873
20	38	2,150	1,967	1,874	1,845	1,820	1,786	1,763	1,747	1,725
25	45	2,958	2,754	2,650	2,617	2,589	2,550	2,524	2,504	2,481
30	51	3,548	3,344	3,237	3,205	3,175	3,135	3,108	3,089	3,065
35	55	3,955	3,758	3,656	3,623	3,596	3,557	3,531	3,512	3,487
SITE INDEX 50										
10	17	380	318	289	280	272	262	255	251	245
15	31	1,495	1,327	1,245	1,219	1,197	1,167	1,147	1,133	1,115
20	42	2,746	2,512	2,393	2,357	2,324	2,280	2,251	2,230	2,204
25	50	3,777	3,516	3,383	3,341	3,305	3,255	3,223	3,197	3,167
30	56	4,531	4,271	4,134	4,093	4,055	4,004	3,969	3,945	3,914
35	61	5,050	4,800	4,669	4,627	4,592	4,543	4,509	4,485	4,454
SITE INDEX 55										
10	19	474	397	360	349	340	327	319	313	305
15	34	1,865	1,656	1,553	1,521	1,493	1,456	1,431	1,414	1,391
20	46	3,425	3,133	2,985	2,940	2,899	2,844	2,808	2,782	2,749
25	55	4,711	4,386	4,220	4,168	4,123	4,061	4,019	3,988	3,951
30	62	5,652	5,327	5,157	5,105	5,058	4,995	4,951	4,920	4,882
35	68	6,298	5,986	5,822	5,770	5,727	5,665	5,623	5,594	5,554
SITE INDEX 60										
10	20	580	485	440	427	416	400	390	383	373
15	37	2,282	2,026	1,900	1,861	1,827	1,782	1,751	1,729	1,702
20	50	4,191	3,834	3,653	3,597	3,547	3,480	3,436	3,404	3,363
25	60	5,765	5,368	5,164	5,100	5,045	4,970	4,918	4,881	4,835
30	68	6,915	6,518	6,310	6,246	6,189	6,111	6,058	6,020	5,973
35	74	7,706	7,323	7,124	7,060	7,007	6,931	6,880	6,844	6 795
SITE INDEX 65										
10	22	699	584	530	514	500	482	469	461	449
15	40	2,747	2,439	2,287	2,240	2,199	2,144	2,108	2,082	2,048
20	54	5,045	4,615	4,397	4,330	4,271	4,190	4,136	4,098	4,049
25	65	6,939	6,461	6,216	6,139	6,073	5,981	5,920	5,875	5,820
30	73	8,323	7,845	7,594	7,518	7,449	7,355	7,291	7,246	7,190
35	80	9,277	8,817	8,576	8,500	8,435	8,344	8,283	8,240	8,181
SITE INDEX 70										
10	24	830	693	630	610	594	572	557	547	534
15	43	3,261	2,896	2,715	2,660	2,612	2,546	2,503	2,472	2,432
20	58	5,991	5,480	5,222	5,142	5,071	4,975	4,911	4,866	4,807
25	70	8,241	7,674	7,382	7,291	7,213	7,104	7,031	6,978	6,912
30	79	9,883	9,315	9,018	8,927	8,845	8,734	8,658	8,604	8,537
35	86	11,015	10,469	10,181	10,093	10,016	9,908	9,836	9,784	9,714
SITE INDEX 75										
10	26	974	814	739	716	697	671	654	642	626
15	46	3,828	3,399	3,187	3,122	3,066	2,989	2,938	2,902	2,855
20	63	7,031	6,431	6,128	6,034	5,951	5,838	5,764	5,711	5,642
25	75	9,669	9,003	8,662	8,555	8,463	8,335	8,249	8,187	8,110
30	84	11,601	10,935	10,585	10,479	10,382	10,252	10,163	10,100	10,021
35	92	12,930	12,291	11,954	11,847	11,757	11,631	11,545	11,484	11,403

Table 3. — Board-foot yield of white pine per acre to 6-inch top diameter (i.b.) International ¼-inch rule.

Age (years)	Original spacing (feet)								
	4 x 4	5 x 5	6 x 6	6 x 7	7 x 7	8 x 8	9 x 9	10 x 10	12 x 12
	Board feet								
SITE INDEX 45									
10	--	--	--	--	--	--	--	--	6
15	--	--	--	--	86	257	403	531	753
20	--	557	1,016	1,199	1,388	1,702	1,974	2,217	2,640
25	1,542	2,311	2,912	3,157	3,411	3,848	4,231	4,575	5,175
30	3,581	4,435	5,137	5,427	5,736	6,256	6,728	7,150	7,883
35	5,650	6,561	7,332	7,659	8,003	8,586	9,117	9,588	10,449
SITE INDEX 50									
10	--	--	--	--	--	--	--	--	50
15	--	--	107	238	366	579	761	921	1,200
20	577	1,327	1,884	2,110	2,342	2,731	3,071	3,377	3,914
25	2,980	3,892	4,623	4,925	5,239	5,783	6,266	6,697	7,454
30	5,837	6,857	7,714	8,073	8,457	9,107	9,699	10,233	11,159
35	8,723	9,815	10,758	11,164	11,592	12,323	12,989	13,585	14,678
SITE INDEX 55									
10	--	--	--	--	--	--	--	37	116
15	--	69	467	623	777	1,034	1,256	1,452	1,795
20	1,551	2,416	3,075	3,346	3,625	4,097	4,513	4,888	5,549
25	4,980	6,030	6,898	7,261	7,642	8,304	8,891	9,424	10,358
30	8,893	10,071	11,092	11,524	11,991	12,786	13,510	14,164	15,310
35	12,780	14,048	15,173	15,664	16,186	17,078	17,896	18,633	19,980
SITE INDEX 60									
10	--	--	--	--	--	--	56	112	207
15	--	518	978	1,161	1,342	1,647	1,912	2,146	2,561
20	2,925	3,896	4,658	4,975	5,305	5,866	6,365	6,815	7,612
25	7,637	8,817	9,824	10,250	10,701	11,493	12,196	12,840	13,970
30	12,849	14,177	15,369	15,878	16,434	17,382	18,256	19,045	20,432
35	17,940	19,374	20,695	21,276	21,898	22,965	23,953	24,842	26,475
SITE INDEX 65									
10	--	--	--	--	--	73	150	216	328
15	418	1,148	1,668	1,877	2,087	2,442	2,754	3,031	3,521
20	4,760	5,823	6,687	7,052	7,437	8,092	8,677	9,211	10,159
25	11,052	12,344	13,491	13,985	14,509	15,435	16,268	17,030	18,376
30	17,860	19,322	20,682	21,276	21,924	23,037	24,071	25,010	26,666
35	24,399	25,987	27,502	28,182	28,906	30,165	31,337	32,396	34,345
SITE INDEX 70									
10	--	--	--	15	81	186	275	352	483
15	1,195	1,982	2,562	2,799	3,038	3,445	3,806	4,128	4,702
20	7,122	8,258	9,222	9,636	10,073	10,828	11,507	12,130	13,240
25	15,333	16,717	17,999	18,561	19,164	20,234	21,203	22,096	23,675
30	24,021	25,594	27,126	27,804	28,550	29,842	31,047	32,145	34,091
35	32,261	33,984	35,691	36,479	37,317	38,780	40,152	41,390	43,683
SITE INDEX 75									
10	--	--	68	143	217	336	437	525	676
15	2,224	3,056	3,691	3,955	4,223	4,686	5,097	5,468	6,135
20	10,064	11,251	12,309	12,771	13,265	14,123	14,905	15,622	16,909
25	20,582	22,026	23,441	24,072	24,753	25,975	27,088	28,118	29,952
30	31,503	33,161	34,857	35,624	36,471	37,951	39,341	40,612	42,873
35	41,736	43,577	45,483	46,362	47,321	49,003	50,581	52,017	54,689

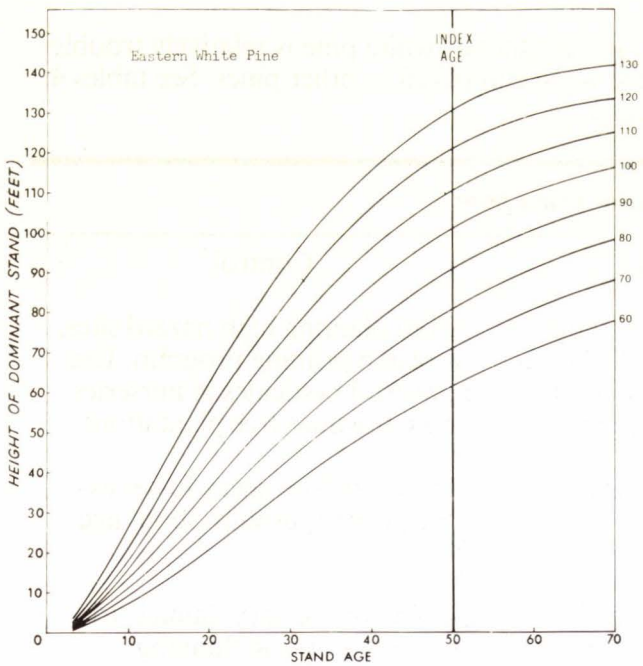

Figure 5. — Polymorphic site index curves for natural stands of eastern white pine in the southern Appalachians.
Source: Beck

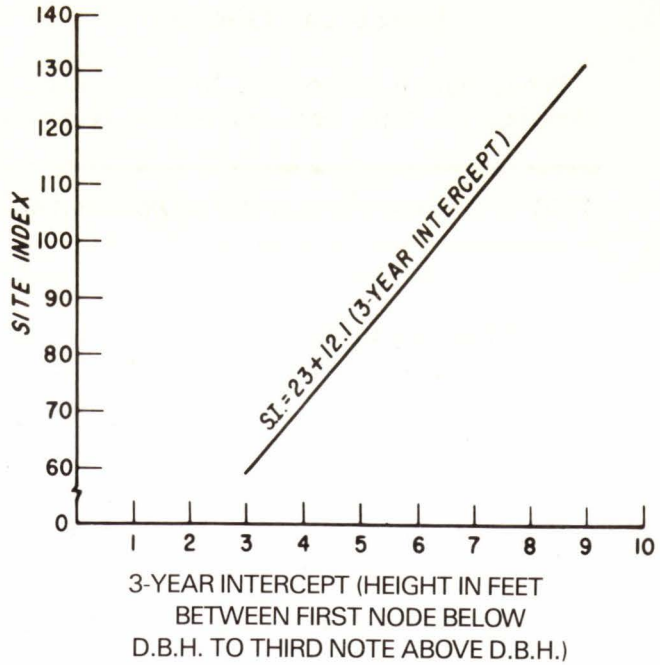

Figure 6. — Relationship of 3-year intercept and site index for natural stands of white pine.
Source: Beck

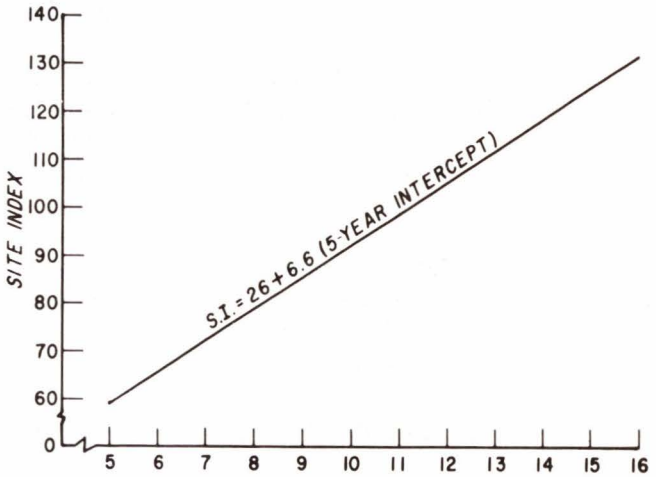

Figure 7. — Relationship of 5-year intercept and site index for natural stands of white pine.
Source: Beck

Culmination of MAI in board-foot volume appears to occur much later than MAI for cubic foot volume. Board-foot MAI is still increasing at age 35 for all sites planted at 12 by 12 spacing. Both MAI and PAI culminate earlier on good sites probably because more trees cross the merchantable threshold sooner due to more rapid diameter growth. PAI, for example, with a 12 by 12 foot spacing, culminates at 2,609 board feet on site 75 (base age 25) between ages 20 to 35, and on site 45 (base age 25) between ages 25 and 30.

Schenk's old orchard eastern white pine plantation at Biltmore, N.C. was established in 1899 with 4-year-old seedlings spaced approximately 3 by 4 feet apart. Including thinned wood, the site index 71 (base age 50) plot produced 12,882 cubic feet of merchantable wood per acre including thinned wood in 72 years, but the unthinned site index 75 plot produced 13,104 cubic feet per acre. Only 45,876 board feet per acre were produced on the thinned plot (including 1,796 board feet per acre removed in six past thinnings), but 51,600 board feet per acre on the unthinned plot.

In contrast, at Sewanee, Tenn., a 27-year-old white pine plantation (site index 60, base age 25) thinned at 11 and 22 years had a total production of 4,600 cubic feet or 22,000 board feet per acre. An unthinned plot in the same stand (site index 65, base age 25) produced 4,600 cubic feet or 14,700 board feet per acre.

Growth and yield information for natural white pine stands in the southern range is scarce. Natural stands seem to grow at relatively slower rates than plantations during earlier years of the rotation because of greater competition from other vegetation.

Insects and Diseases

White pine is susceptible to many diseases affecting root, butt, stem, and foliage. However, in the Southeast, white pine is relatively trouble free when compared to other pines. See tables 4 and 5.

Table 4. — Some diseases and air pollution affecting eastern white pine

Disease	Description	Control
White pine blister rust *(Cronartium ribicola)*	Affects limbs and stems. Highest hazard is above 3,000 feet elevation where Ribes (alternate host) and the disease are present.	Avoid planting high hazard sites, or plan a pruning program. Use approved pesticides in nurseries and Christmas tree plantations.
Heart rot, *(Fomes pini)*	Can cause severe volume loss in old growth stands.	Harvest before decay losses exceed growth, usually about age 70.
Red-brown butt rot, *(Polyporous schweinitzii)*	Enters through basal wounds caused by fire and logging.	Avoid unnecessary damage to leave trees during thinning.
Annosus root rot, *(Heterobasidon annosum;* formerly *Fomes annosus)*	May spread rapidly in deep soils following thinning. Affected trees develop yellow, stunted foliage before death.	Treat stumps with borax during thinning in uninfected stands; in infected stands use Phlebia stump treatment.
Armillaria root rot *(Armillariella mellea)*	Spreads from old hardwood and pine stumps and roots to young seedlings and saplings; worse after stress such as drought.	Control is not attempted for this disease under forest conditions. Losses may be reduced by following proper planting procedures and by salvage cutting.
White pine root decline, *(Verticicladiella procera)*	First appears as top decline, often progressing downward from terminal. More severe on wet sites.	Avoid planting white pine on poorly drained sites.
Air pollution	Shortened, chlorotic needles with yellow bands, some tip burn.	Remove susceptable tree.

Table 5. — Some insects affecting eastern white pine

Insect	Description	Control
Pales weevil, *(Hylobius pales)*	Girdles stem of seedlings.	Areas where timber harvests occur before July 1 can be planted the following planting season. Postpone planting 1 year in areas harvested after July 1. If you are unable to wait, use approved pesticide.
White pine weevil, *(Pissodes strobi)*	Limited problem in South. Kills terminal shoot. Pines are rarely killed, but may be stunted and deformed.	If problem exists, use shelterwood to regenerate.

continued

Table 5. — Some insects affecting eastern white pine — continued

Insect	Description	Control
White pine sawfly, *(Neodiprion pinetum)*	Feeds on old and new needles of young trees. Has one generation per year. Usually takes 2 years for serious buildup.	Natural predators tend to keep in check.
Introduced pine sawfly, *(Diprion similis)*	Currently limited to an area along Blue Ridge Parkway in N.C. and Va. Defoliates during summer and fall. Has three overlapping generations per year permitting a rapid buildup.	Overlapping generations make chemical control impractical except possibly for high value trees. Biological controls appear most hopeful approach.

Management Strategies

Strategies will vary with landowner objectives and marketing opportunities. If the objectives are to maximize early returns with sawtimber as the final product, and markets are available for small material, plant 450 to 700 trees per acre (approximately 10 by 10 foot to 8 by 8 foot spacing). Make fairly heavy thinnings, starting at an early age to maintain rapid diameter growth on residuals and increase board foot volume yield. On site index 110 (base age 50) the tree of average basal area at age 10 is 4.0 inches in a plantation with 4 by 4 foot spacing, versus 6.7 inches in a plantation with 12 by 12 foot spacing. Plantations on the best sites accumulate basal areas of 230 to 240 square feet per acre in 20 years. Such stands should be thinned back to 150 to 175 square feet of basal area at about 18 years. Stands on poorer sites should be thinned even more heavily when slightly older. Thinning dense stands of white pine is very difficult physically because of persistent side branching.

If maximum production of cordwood is the objective, plant white pine at a spacing of 6 by 6 or 8 by 8 feet; clearcut at age 25. Yields on the best sites should be about three times greater than those on the poorest sites. Low specific gravity of white pine (.34 green) penalizes sellers where wood is bought by weight. However, demand for white pine cordwood is limited. If you manage white pine for sawtimber, your returns will be far greater per acre per year.

For short rotations with sawtimber the final product, or where there is a poor market for cordwood thinnings, plant 300 to 500 trees per acre (about 12 by 12 foot to 10 by 10 foot spacing, or the equivalent). The Virginia Division of Forestry has found that a maximum of about 350 trees per acre will reach 9.5 inches d.b.h. (minimum sawtimber size). They recommend planting 400 to 500 seedlings per acre where pulpwood markets are lacking. Thinning opportunities will depend on local markets for small logs. Consider thinning at age 18 to 20 and again at age 30 at the higher densities. For the furniture market, final harvest should be made around age 35 to 40 because relatively small logs with sound knots are most in demand.

Tree Improvement

Only in recent years has information on geographic variation and the heritability of various traits been available for eastern white pine. Evidence has now accumulated that indicates a wide variation in height growth can be accounted for by seed source. A Tennessee study found that northern seed sources are inferior to southern Appalachian sources for use in Tennessee. Evidence from this study indicates more intensive sampling is needed to capitalize on this apparent variation. Gains of 18 to 26 percent in juvenile growth were realized through selection of the best 30 percent of the families included in this study. Based on this study, seed from Morgan County is collected by the Tennessee Division of Forestry for use in their nursery.

An earlier study involving plantations in Georgia, North Carolina, and Virginia found that, for Georgia and North Carolina, local or southern Appalachian seed is clearly the best. In Virginia, the picture is not as clear, but evidence of white pine from southern Appalachian seed sources growing well farther north suggests that local or southern Appalachian seed sources should be used in Virginia.

Christmas Trees

Successful Christmas tree plantations of white pine are being grown in North Carolina, Tennessee, and Virginia. White pine withstands a wide range of temperatures (from above 100° F to well below freezing) and is less susceptible to snow and ice damage than stiffer-branched species. However, this species is intolerant of drought and floodings. It is also very susceptible to air pollution, as well as a wide variety of root diseases and insects.

White pine has gained in popularity for use as a Christmas tree in the eastern and southeastern States, commanding 30 to 40 percent of some markets. In 1978, over 2 million white pine seedlings were planted in North Carolina alone for Christmas trees. While some will end up as ornamental stock, over half probably will be used in the cut-tree market. To compete successfully with other species in this market, white pine must be of high quality. Careful attention should be given to all cultural practices, but especially important are site selection, seed source, spacing, insect and disease control, animal protection and shearing.

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Metric Conversions

1 inch = 2.54 cm
1 foot = 27.94 cm
1 foot^2 = 0.0929 m^2
1 foot^3 = 0.283 m^3
1 acre = 0.4047 ha
1 board foot (12 x 12 x 1 inch thick without bark, ¼-inch Int. Scale) equals 0.00348 m^3.

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PESTICIDE PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key – out of the reach of children and animals – and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your State forestry agency, county agricultural agent or State extension specialist to be sure the intended use is still registered.